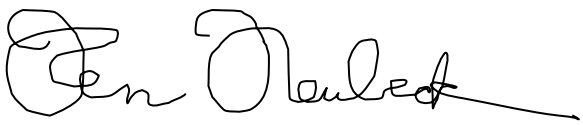
# CURRENT UNDERSTANDING OF SPORADIC-E

**By Ken Neubeck WB2AMU**

VHF radio amateurs are rewarded with the treat of Sporadic-E propagation, a phenomenon that can make a quiet Six Meter band suddenly get filled with loud signals. The phenomenon has been the subject of many myths and half-baked theories over the years, particularly by radio amateurs who often make casual observations without making the use of the available scientific data. One such myth is the fact that Sporadic-E is weather-dependent; that it is directly related to the presence of thunderstorms. Only a handful of papers have looked at this theory and at best this may be an indirect factor where Sporadic-E may be enhanced but not actually formed. Thus, it is the intention of this presentation that facts obtained directly from scientific studies are presented in a comprehensive manner so that no misunderstandings remain.

The author has spent the better part of the past fifteen years studying the Sporadic-E phenomenon on Six Meters and researching all available scientific books, papers and data. As part of this effort, several years worth of ionosonde data from several stations located throughout the world was examined for the occurrence of Sporadic-E on a daily basis. Also, a number of groundbreaking books on Sporadic-E written by Dr. Ernest K. Smith were obtained, along with many papers that were presented in the Space Research Series. With advances in the Internet, recent papers on the subject and related phenomenon have also been obtained. The information that is presented here is based on known phenomenon and not on speculation.

Because of the complexity of the Sporadic-E phenomenon, a different approach is used in this presentation, that of using a graphic comic strip. It is hope that this approach that is taken here will help make this complex phenomenon a little clearer and interesting to the VHF radio operator.



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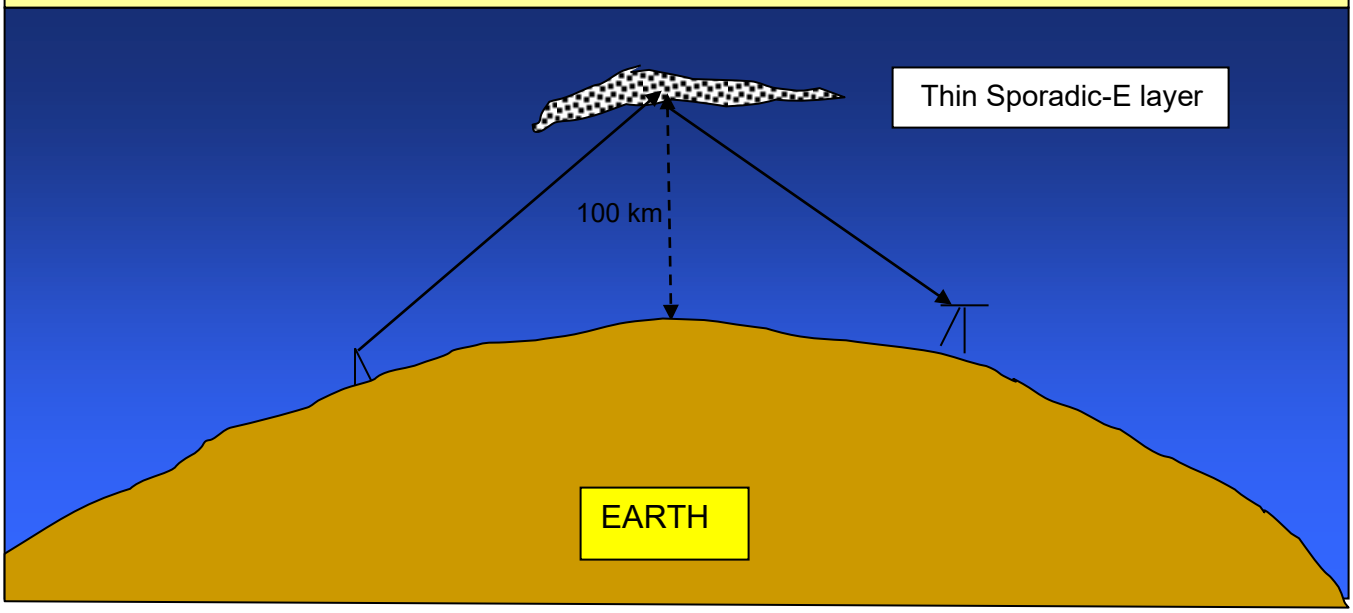
# THE SPORADIC-E FILES

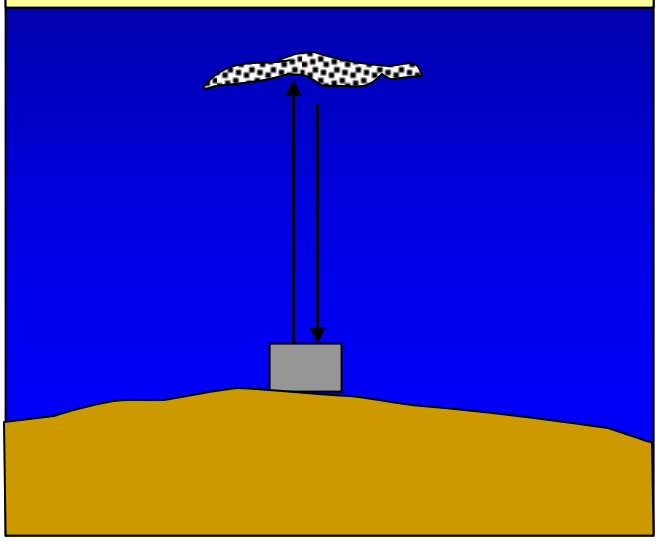
**Narrated by Ken Neubeck, WB2AMU**

**TOPIC # 1: Introduction to an amazing VHF radio propagation phenomenon**

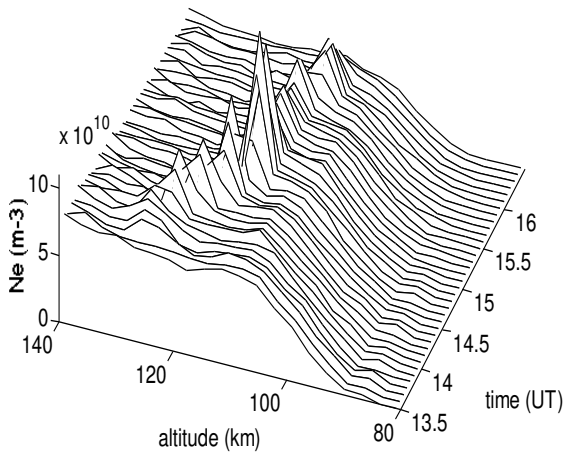
Sporadic-E has been the center of interest for both radio amateurs and scientists since its discovery on the Five Meter band in 1935. It is one of the major propagation modes that appear on the Six Meter band in force during the summer months as well as during a minor winter season.




Initially, Sporadic-E would be measured by ionosonde stations, that are located in different areas of the earth. These stations would send a sweep of frequencies vertically until a specific frequency (or critical frequency) is reflected back to the station. In subsequent years a series of rocket launches into active Sporadic-E formations would also take place.



In recent years, additional methods for measuring Sporadic-E were developed, such as EISCAT radar and satellites. The plot below shows a thin Sporadic-E formation.



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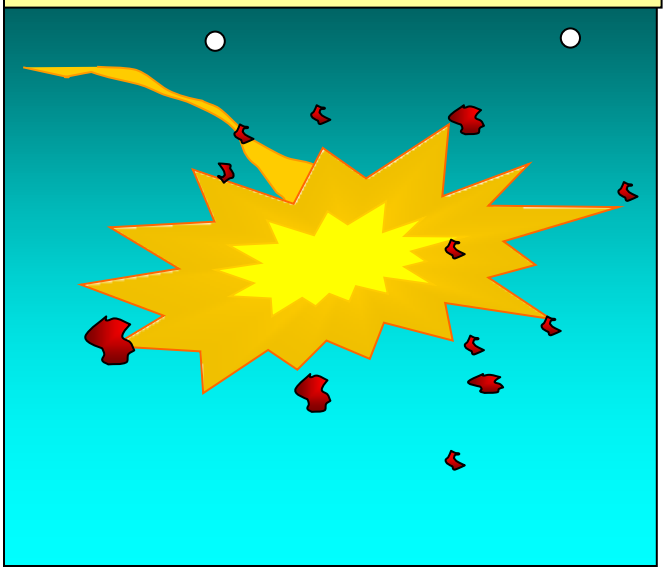
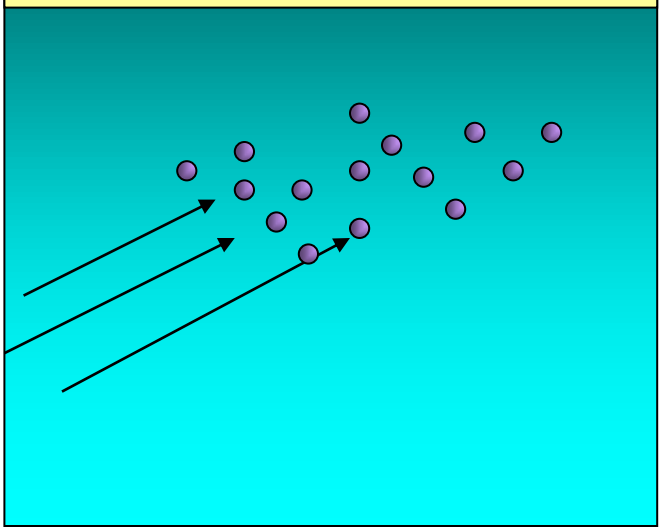
**TOPIC # 2: The basic mechanisms of the summertime Sporadic-E season**

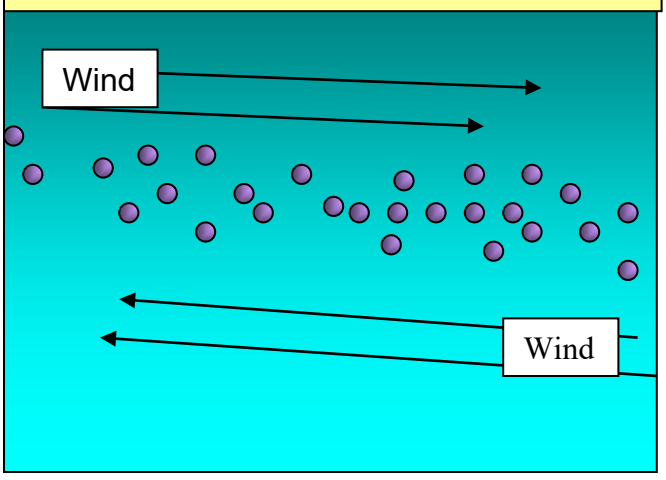
Sporadic-E ions originally come from the metallic particles (typically iron and magnesium) that result from meteor ablation in the E-region of the ionosphere. These particles will eventually fall down to the level of 90 km above earth.



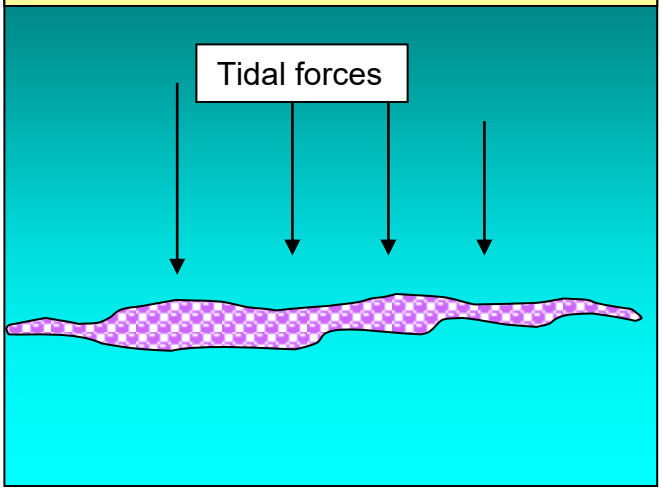
At around the height of 90 km, some particles are oxidized and fall down to earth while the remaining particles combine with existing oxygen ions (the oxygen ions are at their highest levels during the summer season). Ionospheric winds then transport these metallic ions upward into the E-region to above 100 km.



Between 120 and 100 km, the action of opposing ionospheric winds causes the effect of wind shear, resulting in the accumulation and compression of these particles into thin stratified layers. Each layer is like an invisible ion mirror that is capable of reflecting radio waves. As the density of the layer increases, higher frequency radio waves can be reflected.




The lifetime of a Sporadic-E layer is limited, on the order of a few hours or more. This is because of the gravitational effects of tidal forces that push the layer down to the lower altitudes until it reaches 90 km and dissipates. Some ions are oxidized and fall to earth while others recombine with oxygen ions and again return into the E-region reservoir of ions.



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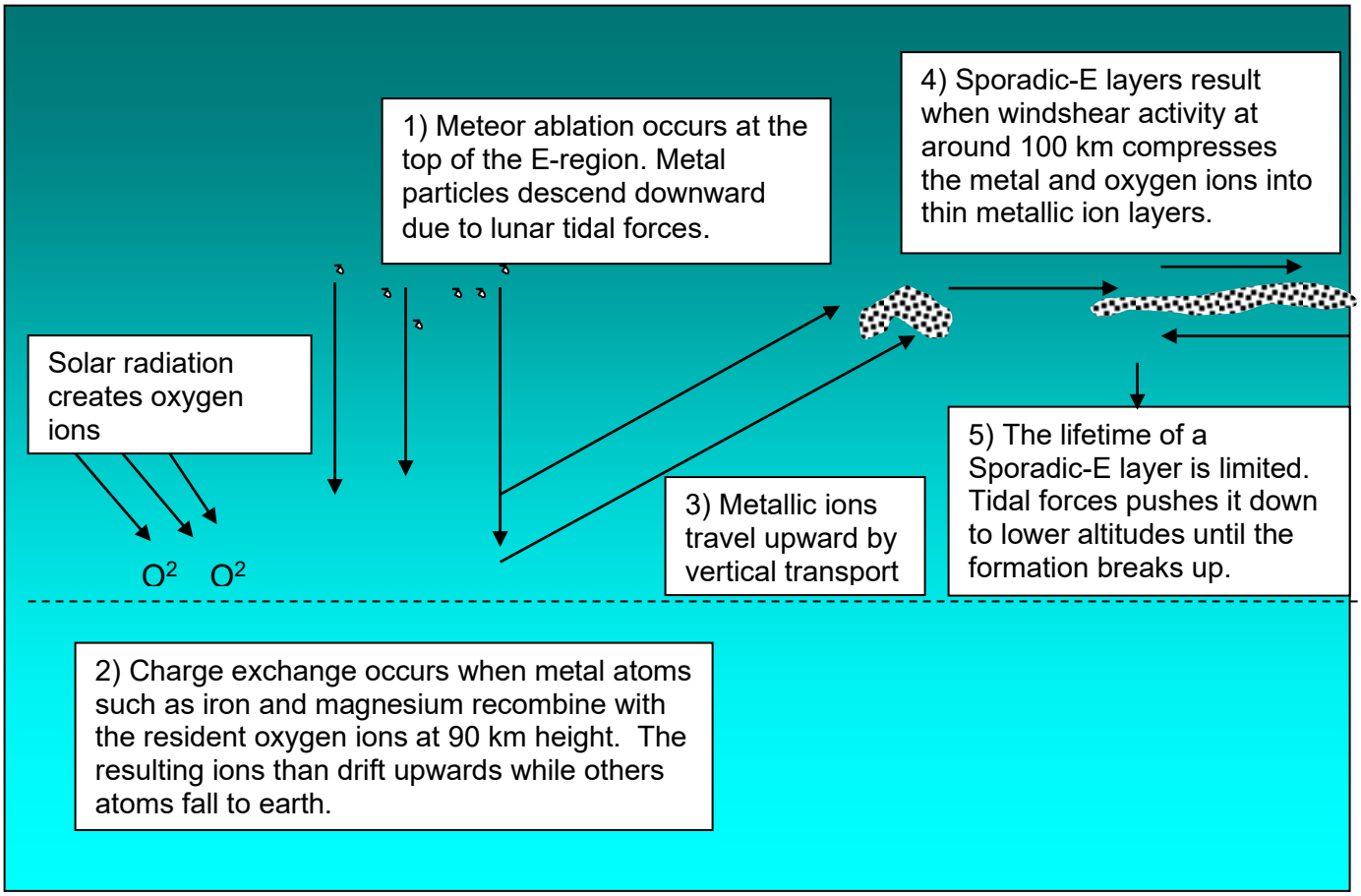
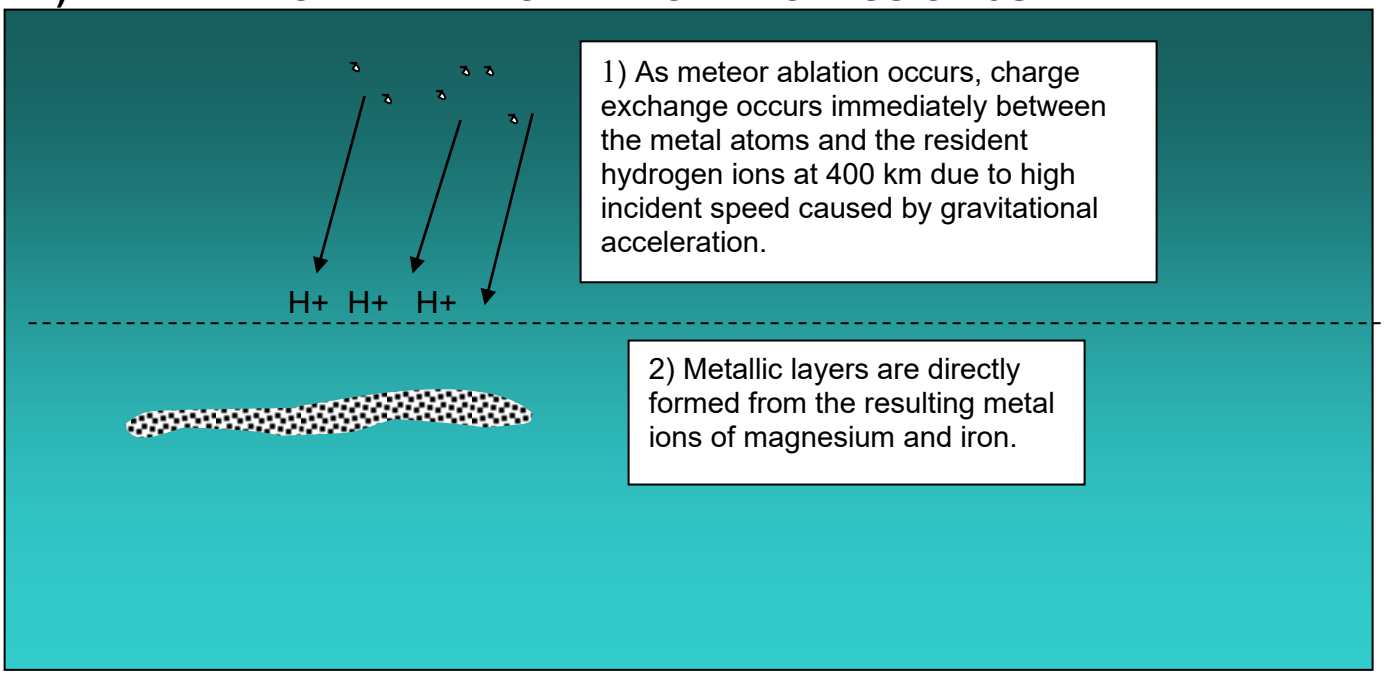
**TOPIC # 3: Comparison of Sporadic-E layer on Earth with other planets**

## A) METALLIC ION LAYER PROCESS ON EARTH




## B) METALLIC ION LAYER FORMATION PROCESS ON JUPTIER



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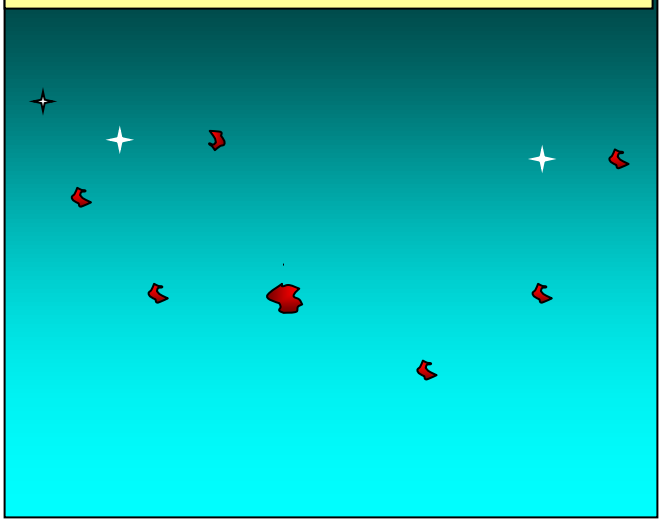
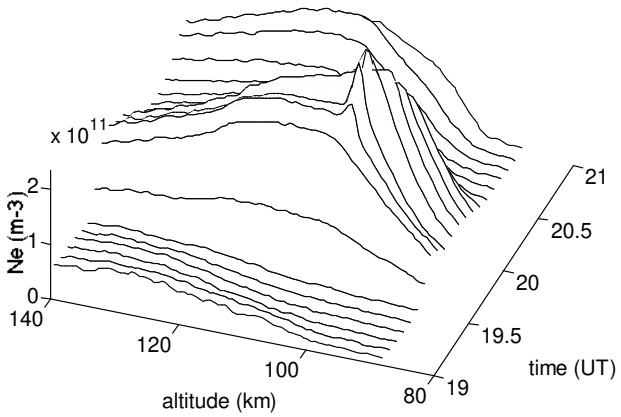
## TOPIC # 4: Why is there a lack of Sporadic-E during March and September?

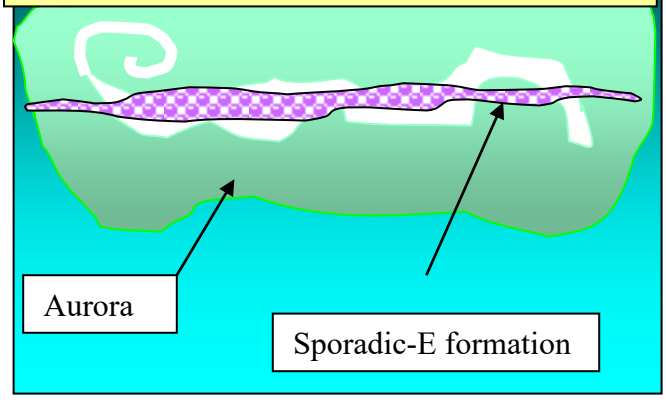
There is a significant lack of Sporadic-E activity during the equinox months of March and September. One possible factor that may be involved for this situation is the reduced level of oxygen ions in the 80 to 100 km region of the ionosphere as compared to the summer months. This will result in less metal ions being created at the 90 km level, meaning that most metal particles will oxidize and fall to earth.



However, this factor alone cannot account for the near-total disappearance of Sporadic-E during these months. EISCAT radar plots show some cases at high latitudes show where Sporadic-E formations seem to be embedded inside aurora formations. In some cases, this can develop into Aurora-E. It is suspect that aurora formations may actually block the presence of Sporadic-E during these months.




Indeed, the unique signals of aurora-E formation have often been observed on the Six Meter band after a particularly intense aurora opening. Looking at EISCAT radar plots of these formations, it has been observed that Sporadic-E formations are embedded inside the aurora formation and will eventually dissipate inside the aurora.




There would appear to be a reduction of resident Sporadic-E ions in the E-region during the period of the equinoxes because of the increased presence of aurora along with other associated factors related to the magnetic field lines. As a result, very few Sporadic-E openings are observed during the equinox period.